Calculations of capacitance in laser-driven solenoids

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We present a series of one and two-dimensional EPOCH (particle-in-cell) simulations that explore the impact of an interstitial plasma plume on the capacitance of laser-driven solenoids. Recent work suggests that these solenoids can be accurately modelled by a "lumped-element" RLC circuit, provided their inter-plate capacitance is around 3-4 orders of magnitude higher than their geometrical capacitance [1]. It is thought that Debye shielding of the inter-plate electric field by the laser-generated plasma plume may be responsible for this augmented capacitance [1]. We examine this claim using EPOCH simulations of two plates with an interstitial plasma distribution. By solving for the $\underline{E}$ and $\underline{B}$ fields between the plates, estimates of the capacitance are calculated and used to test the validity of the RLC circuit model. A better understanding of the mechanism that underpins magnetic field generation in laser-driven solenoids could have important implications for many fields within magnetized high energy density (HED) systems, including inertial confinement fusion (ICF), charged particle collimation, fast ignition and laboratory astrophysics [2-6].

References

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